DEVELOPMENT OF PERIODIC TABLE INTERACTIVE INSTRUCTIONAL MULTIMEDIA IN CHEMISTRY LESSON FOR Xth GRADE SMA / MA

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Abstract- Periodic table is one of chemistry lesson which consist of many concept and need rote. It can cause students forget about this lesson after being learned. Beside that, The periodic table is a bridge of knowledge that becomes the basis and key of chemistry lesson. One alternative that can help students to remember and understand about periodic table is to use computer-based instructional media such as interactive multimedia. Interactive multimedia can stimulating many sense (auditory, visual and kinesthetic) so that students is stimulated to active in studying. The involvement of the various sense aims to be able to receive and process information that can be retained in the memory. The purpose of this research are to create interactive multimedia of periodic table and determine the validity and practicality of the media. This research use the R&D research with using Plomp model that consist of three phase (1) Preliminary Research, (2) Prototyping Phase and (3) Assessment phase. This multimedia is validated by 3 chemistry lecturers and 2 chemistry teachers. Practicability is done by 30 students of SMA Pembangunan UNP and 2 teachers. Data retrieval technique is by administering questionnaires to students who are then analyzed using a Likert scale. the result of Validity test is 0,81, practicability from teacher is 0,92 and practicability from students are 0,81. The result show that interactive multimedia of periodic table are valid and practice to be used as an Instructional multimedia.

Keywords : Interactive Instructional Multimedia, Periodic Table, Plomp Models, Validity, Practicability

I. INTRODUCTION

Periodic table is a subject which need rote. It can make students difficult to remember it, so that take effect on the achievement of the students mark who tends low. Based on observation in Senior High School Pembangunan Laboratory UNP, 60% students in Xth grade is not reach the KKM in periodic table of chemistry elements. This is because there are material which need high order thinking. The material is about periodic table trends. The criteria of this material are abstract and need rote to study it. The students are difficult to understand periodic trends of the elements based on elements periodicity properties.

The material which place in the end of competency also cause the material is presented briefly and less exercise causing time constraints, so that the students are easy to forget this material. Based on description above, we can know that retention of students is related to learning outcomes.

In the absence of re-learning, most students will recall close to 25% of the information obtained within a week and

close to 21% if within 2 to 4 weeks. Retention will decrease over time, so retention should be retained as much as possible with the repetition of material^[1]. The learning process will be currently if the students have good retention. One effort to improve the retention capability is to use instructional media.

Multimedia is a medium that combines two elements or more media (text, sound, graphics, animation, and video) to convey information, then added the sixth element is interactive^[2]. Based on the description above, can be concluded that interactive multimedia is a combination of text media, images, video, animation, and sound that can be presented simultaneously so as to generate user interactivity that can cause stimulus (stimulus) various senses so that users can receive and process information then maintained in his memory. The involvement of the various senses is not only auditory and visual, but also kinesthetic. Its means beside seeing and listening, students are stimulated to be active in learning by interacting with Interactive multimedia provided. The involvement of the various senses aims to be able to receive

and process information that is then retained in memory. Using multimedia in learning can make learning become easier because of the visualization of abstract material and can present events that can not take place in the classroom. Visualization using this multimedia can help students understand the material learned both in macroscopic, microscopic and symbolic^[3].

Based on observations, the facility in school that support teachers to use interactive instructional multimedia in the classroom have not been fully utilized. Teachers only use power point presentation, where the media presentation only serves as a teaching tool, not an instructional medium that can help students to study independently. This is different from the interactive instructional multimedia that can use for self-learning by students^[4].

The development of interactive instructional multimedia has been developed by Andhika Baruri (2013) on chemistry subject matter reaction rate as medium for high school students. This research states, interactive instructional multimedia is very feasible to be used as a medium of learning^[5]. Therefore, researchers are interested to develop interactive instructional multimedia on the subject Periodic Table on chemistry elements. Based on the descriptions above, it is necessary to develop interactive instructional multimedia on the material of the periodic table in order to achieve the learning objectives that have been determined. Based on the above background then do the research with the title "Development of Periodic Table Interactive Instructional Multimedia in Chemistry Lesson For Xth Grade Sma / Ma

II. RESEARCH METHODS

The research that has been done is included in the Research and Development (R & D) research category. Type of research and development is a research method that used to produce a particular product^[6]. This research uses Plomp development model. This model consists of three development stages: Preliminary Research, Prototyping phase and assessment phase^[7]. The steps of developing interactive instructional multimedia of periodic table of elements that researchers do can be detailed as follows:

1. Preliminary Research Phase

The purpose of this stage is to define the requirements required in the research of interactive media development on the material of the periodic table elements of Class X SMA/MA. The steps taken are as follows.

a. Needs analysis

Needs analysis is done to see the description of conditions in the field related to the learning process of chemistry in school. At this stage, observations and interviews are conducted to find barriers faced by teachers and students in chemistry learning on the material of the periodic table of elements

b. Curriculum analysis

In the curriculum analysis, the activity is to analyze Basic Competence (KD). This analysis aims to formulate the concepts of learning on the material periodic table of elements

in X class SMA. The basic competence for the periodic table material consists of three KDs that are KD 3.4 Analyzing the similarity of the elemental properties in the groups and their periods, 4.3 determines the location of an element in the periodic table and its properties based on the electron configuration and KD 4.4 explains the resemblance and the nature of the element based on the data of the properties -the periodic nature of the elements.

c. Material Analysis

Material analysis is performed to identify, itemize and systematically arrange the necessary concepts and make reference in developing Interactive instructional multimedia.

d. Students analysis

Student analysis is conducted to examine the character of the students who become the target users of the products produced. This analysis is done by interviewing the chemistry teacher about the characteristics of the students, including academic ability, learning motivation and student age.

2. Prototyping Phase

At this stage is done media design that includes: the formulation of learning objectives, designing media, and preparing research instruments and the realization of the resulting design.

a. Design of prototype I

Prototype I was developed in the form of interactive instructional multimedia. At the design stage carried out the specification of learning objectives. In addition, media designers also do.

b. Design of prototype II

At this stage, an expert review is made to see the validity of the media in terms of language, construction, technique and formative language used in the form of validation sheets. Revision of prototype II is based on the assessment and suggestions provided by experts. The quality criteria to be obtained at this stage is the relevance, consistency and have practicality as expected. Suggestions from validators are used to revise the developed Interactive learning multimedia.

c. Design of prototype III

This stage emphasizes the practicality of interactive multimedia by doing one to one evaluation of three students of class X in senior high school. This test is conducted on students who have different abilities (high, medium and low). Formative evaluation undertaken at this stage uses an interview sheet and a student practice sheet on one-on-one evaluation and then proceeds at the prototype IV development stage.

d. Design of prototype IV

The next step is a small group evaluation of six until seven students in X grade. Small group evaluation is done by explaining the steps of interactive instructional multimedia then students are told to use multimedia learning of the elemental periodic system and fill out the questionnaire of practice. The results of students' practicality on small group evaluation are

then continued in the assessment phase by conducting a large group test (field test).

3. Assessment Phase

At this stage, a formative evaluation was conducted to grade X students who aimed to see how far the practicality of interactive instructional multimedia on the material of the Periodic table of Elements was developed. Practical testing is done by filling out the media practicality instrument that filled by teachers and students, after the media is declared valid by the validator, then conducted a limited trial to get data about the practicality of media use in the field. The test subjects in this study were the students of class XII IPA in Pembangunan Laboratory UNP high school Padang. The quality or not the product produced can be seen from the validity and the learning multimedia instructional practices. Analysis of development data is processed using kappa moment formula.

$$\text{moment kappa (k)} = \frac{P - P_e}{1 - P_e}$$

information :

K = Moment kappa that shows Product validity

P = The realized proportion, calculated by the number of validated values divided by the maximum number of values

Pe = Unrealized proportion, calculated by the sum of the maximum value minus the total number of validated entries divided by the maximum number of values.

Table1. Category Decision based on Moment Kappa (k)

Interval	Kategori
0,81-1,00	Almost perfect
0,61-0,80	Substantial
0,41-0,60	Moderate
0,21-0,40	Fair
0,01-0,20	Slight
< 0,00	Poor

(Boslaugh, 2008 : 12)

III. RESULT AND DISCUSSION

A. Result

Development models for this research is Plomp models, consist of three phase. The steps taken are as follows:

1. Preliminary Research Phase

The purpose of this stage is to define the requirements required in the research of interactive multimedia

development on the material of the Priority Element System of Class X / SMA. The steps taken are as follows:

a. Needs analysis

Needs analysis is done to see the description of conditions in the field related to the learning process of chemistry in school. At this stage observations and interviews are conducted to find barriers faced by teachers and students within learning chemistry on the material of the periodic table elements. Based on the results of the interviews are known in the material of the periodic table of elements have been equipped with instructional multimedia in the form of powerpoint, but not independently by finding the concept through the questions given, and multimedia that can be used anytime and repeatedly so as to improve students' Periodic elements that are memorizing.

Based on the results of observation, it can be seen that students in SMA Pembangunan Laboratorium Padang and students in SMA N 1 Bukittinggi do not have interactive instructional multimedia of the elemental periodic system that students can use independently to repeat the material of the rote periodic table of elements. The media which students used in studying the periodic system of elements was the powerpoint media which used during chemistry learning. Based on the questionnaire needs can be seen that the powerpoint media was used does not help students to learn independently. This is because media powerpoint is a medium is used as a tool in the learning process, so it is not suitable to be used as an interactive media that can help students learn independent^[4].

b. Curriculum analysis

In the curriculum anaisis, the activity is to analyze Basic Competence (KD). This analysis aims to formulate the concepts of learning on the material system periodic of element in X class SMA.

Basic competence for materials Periodic System Elements consist of three KD are: KD 3.4 Analyzing similarity properties of elements in groups and periodicity, 4.3 determine the location of an element in the periodic table and its properties based on the electron configuration and KD 4.4 Reasoning of similarities and periodicity properties of elements based on data properties -the periodic nature of the elements. To analyze basic competencies, there are two dimensions to be considered namely the cognitive dimension and the dimension of knowledge. Dimensions of load cognitive processes of cognitive processes of the students must achieve basic competence, while the dimensions of knowledge covering the types of knowledge of the demands of KD.

c. Material Analysis

Material analysis is performed to identify, itemize and systematically arrange the necessary concepts and make reference in developing Interactive instructional multimedia. Based on the indicators that have been formulated from KD then carried out the material analysis phase. Based on the analysis required learning multimedia easily understood, with an attractive appearance of animated images and interactive questions based on concepts that will be outlined to the students so that students understand their lessons.

d. Student analysis

Student analysis is done by interviewing the chemistry teacher about the characteristic of learners, such as academic ability, learning motivation and student age. Based on the interviews conducted, it can be seen outline the characteristics of students in learning is as follows.

1) Students' academic ability in chemical materials is heterogeneous. This means that there are students who have high academic ability, medium and low. This can be seen from the results of student learning on this material, it can be said that the average value of students in the class has a medium academic ability.

2) Students are easy to forget the concept learned, because the student is familiar with reading and memorizing a concept.

3) Lack of student interest to read the teaching materials they have.

4) Students prefer learning by using media

Interesting learning and using images, animations, tables and experimental videos. Students stated that the display of instructional multimedia is less interesting to make students less motivated in learning.

5) Students who sit in X class high school has age range 14-16 years. Based on the psychological development of students aged between 14-16 years has entered the last stage of the stages of cognitive development. At this stage teenagers already have the ability to think logically, abstract and draw conclusions from the available information [8]. With the media of learning, the students will more quickly understand the concepts on chemicals.

The results of this analysis is the background of the need to do. The development of interactive instructional multimedia that is expected to facilitate students in finding concepts and improving students' understanding on chemistry materials. With the interactive instructional multimedia of periodic elements are expected to increase the sense of curiosity students to learn and attract the attention of students in studying chemicals..

2. Prototyping Phase

At this stage the interactive multimedia design of the elemental periodic system is produced. Multimedia is designed to refer to the theory of learning konstruktivisme because multimedia created provide opportunities to students for the learning process and learning intent really come from the students.

This instructional multimedia includes material content in the form of text, images, tables, videos, and animations. This content runs in offline mode, so the app does not require an internet connection to run it. This instructional multimedia presents the questions that guide the students in understanding and remembering the material of the rote elemental elemental system. The questions are varied such as multiple choice questions and questioning questions.

At the stage of prototype formation, there are four prototypes produced are:

a. Prototype I

Prototype I was developed in the form of interactive instructional multimedia. At the design stage carried out the specification of learning objectives. In addition, also done media design. Interactive multimedia is made using power point applications and converted into flash using the application ispring suite 8. The design of media in this study, contains of images, animations, videos, graphics and data tables. In the design stage of initial media design, the initial steps that can be done include determining the prerequisite materials (initial knowledge required) and new material in accordance with the indicators, then done media design.

The initial design of this instructional multimedia is also called as prototype 1. Formative evaluation in the form of self evaluation is done after prototype one is completed. Self evaluation is performed using checklists aimed at providing an assessment of the first interactive interactive design developed. The results of self evaluation indicate that the design of multimedia made must be improved from the aspect of the learning objectives. The purpose of learning serves to measure the specific behavior of learners, then in formulating learning objectives, must be made clear and specific. Before the revision of learning objectives to 6 and 7 is not specific because in one learning objective there are several concepts namely understanding of atomic radius, ionisation energy, electron affinity and electronegativity

b. Prototype II

The result of prototype 1 is then given to experts to see the validity of the media in terms of construction, technique and language used. The instrument used to test the validity of instructional multimedia is a validation sheet. The validity

test aims to know the category of validity from the instructional multimedia of the periodic elements system. The validation sheet on this media is compiled based on media function are cognitive, compensatory and attention function. The average yield of kappa keseluruhan moment can be seen in Table 1

Table 1. Average acquisition of kappa moment

No.	Rated aspect	K	Validity category
1.	Cognitive function	0,82	Almost perfect
2.	Compensatoris fungtion	0,79	Substantial
4.	Attention function	0,82	Almost perfect
Rate		0,81	Almost perfect

Validity test on the media of the periodic element system is done by the validator ie the lecturer and the teacher. The validator looks at the developed media then fills in the validation sheet provided. Validator also give input of criticism and suggestion to instructional media. The validity test in this research is done by 5 validators ie 3 chemistry lecturers and 2 chemistry teachers. The number of validators has met the requirements that the number of validator or expert opinion to test or validate a product of at least 3 people^[8]. The more validators used then the instructional multimedia will be more valid.

The results of data analysis of the five validator obtained categories of very high prevalence. This suggests that the developed medium is very valid for use for learning. Validity of interactive media is seen based on the function of interactive media that is cognitive function, compensatory function and attention function. after validation and revision of prototype 2, then done one to one evaluation to 3 students who have low ability, medium and high.

The results of the revision of the expert and the difficulties experienced at the time of one to one serve as a basis for revising the prototype and called the second prototype. Some revisions based on validator suggestions and the results of one to one evaluation of the created multimedia are as follows:

- 1) Changing Name compotition of the group of elements and instructions for media usage
- 2) Changing Background during quiz "let's memorize the periodic system element"
- 3) Adding information to the conclusion of the tendency of

atomic radius

c. Prototype III

The result of the revised prototype II, then tested to 8 students or also called small group test. In this experiment the researcher asks the students' opinions through questionnaires about the practicality of the program being developed. In a small group trial, 6 students were taken from grade XII IPA 2 SMA Pembangunan UNP. The goal is to explore information about all obstacles faced by learners when trying or using multimedia learning programs or weaknesses that the program has from various aspects according to the point of view of the learners.

The average assessment data of kappa moment on the three aspects by students on small group test can be seen in Table 2.

Table 2. Average Rating Data K value against Ease of Use and Benefit

No.	Rated aspect	K	Practicability category
1	User ease	0,82	Almost perfect
3	Benefit	0,80	substantial
Rata-rata		0,81	Almost perfect

Based on Table 2, the assessment of developed interactive media practicability obtained a very high level of practicality with the value of kappa moment of 0.81. From this data, the interactive multimedia is very practist use as a medium of learning for the material of the periodic table elements.

The practicality of the interactive instructional multimedia that is produced is very high, but there are still some components that must be improved in accordance with the suggestions given by the students in small group trial that is:

- 1) add media instruction usage on quiz relation of electron configuration with elemental periodic system
- 2) Changing the enter button on multimedia learning with start button
- 3) Change the answer key to the Ti electron configuration problem

d. Prototype IV

The revised prototype III results are referred to as prototype IV, where the prototype IV will be tested for its practicality. In this experiment conducted with a broader respondent is on 30 students or also called a large group test (Field Test).

3. Assshesment Phase

At this stage the resulting prototype IV was tested on 30 students of class XII IPA 1 SMA UNP Development Laboratory. The large group test aims to determine the degree of feasibility of the product with an assessment that includes ease of use and media benefits. In addition to the students, multimedia learning practice test is also done to two high school chemistry teachers. Practicality data is obtained from teacher questionnaire response and student response questionnaire. The average value of kappa moment value data on the aspects of ease of use, the efficiency of learning time and the benefits by teachers on the practicality of interactive multimedia developed as a medium of learning chemistry can be seen in Table 3.

Table 3. Average Assessment Data Value k on Ease of Use, Efficiency of Teaching and Benefit by Chemistry Teachers

No.	Rated aspect	K	Practicability category
1	User ease	0,83	Almost perfect
2	Time efficiency	1,00	Almost perfect
3	Benefit	0,95	Almost perfect
Rata-rata		0,92	Almost perfect

Based on Table 3, the assessment of developed interactive media practicum obtained a very high level of practicality with the value of moment kappa 0.92. From this data, the interactive instructional multimedia subject of the periodic system of elements developed very practist to use as multimedia learning.

Practicallity of interactive instructional multimedia of s periodic table elements that are developed can also be seen from the results of the questionnaire assessment of student responses. Practical test conducted by SMA students of UNP Laboratory Development as many as 30 students. The data of average assessment of kappa moment value on the aspects of ease of use, efficiency of learning time and benefit by students on the practicality of interactive multimedia developed as a medium of learning chemistry can be seen in Table 4.

Table 4. Average Assessment Data K-Value on Ease of Use, Efficiency of Learning Time and Benefit by Student

No.	Rated aspect	K	Practicability category
1	Easy of use	0,81	Almost perfect
2	Time efficiency	0,79	Substantial
3	Benefit	0,82	Almost perfect

Rate	0,81	Almost perfect
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Based on Table 4, the assessment of the development of learning chemistry developed chemistry developed a very high level of practicality with the value of moment kappa 0.81. From the results of this practice, interactive instructional multimedia developed very practical use as a medium of learning on the material of the periodic elements system. Practical data of students and teachers on instructional multimedia has a very high level of practicality, it can be concluded that this media can help students repeat the lesson and consolidate the concepts that have been learned in school based on video, animation, symbols and questions are displayed clearly. The media displayed can also increase the students' motivation to learn independently.

B. Discussion

1. Validation of instructional media

The result of the five validator data analysis Indicates that interactive learning multimedia is categorized as highly valid(almost perfect) used as a learning medium for the material The periodic table of elements , with the average gain of kappa moment is 0.81 The validity of this instructional multimedia is seen based on the function of instructional media, ie Cognitive function, compensatory function and function attention. Affective function is not used on the sheet validation. This is due to the affective function of instructional multimedia is visible from students' enjoyment when learning to use instructional media^[10].

Results of data processing from validator to cognitive function of this instructional multimedia Shows the average of moment kappa amounted to 0.81 with the category of almost perfect, because the suitability of the content of the instructional multimedia with Indicators and learning objectives developed from basic competencies^[10]. This media can also make it easier for students in understanding the concepts contained in material of the periodic elements system. In addition to the media, also added with the questions. These questions can be Improve students' understanding of the material chemistry, as well as problems used in the appropriate exercise with the purpose of learning. Instructional Media can also provide an opportunity for students to repeat learning whenever it is sustainable because of this medium can be used for self-learning so intention learning really comes from students. It is could be said that the nature of learning control comes from Students^[11].

The validity of the functional aspects of media Compensatoris got the category of validity and media which is substantial and with an average of 0.79 kappa moment. This shows that result of media makes it easier for students within understand and remember existing concepts on the material of

the periodic elements system through animation, images, tables and videos are displayed as well as equipped with Interactive questions that guide students to find concepts on the 1 Chemistry materia^[10]. This medium can also help students who weak and slow in receiving the content of the lesson presented by teachers in the media because of the instructional multimedia Presents animated displays, images, tables and video^[10].

Media's validity from aspects of attention is highly categorized. Categories were obtained High with an average of 0.82 kappa moment. This is due to interactive istructional multimedia has design and color is interesting, the type and size of the letters is used can be read clearly, which language used easy to understand. Other than that, with the combination of animation, images, tables, videos, sounds and music on the media can attract attention and curiosity of students in following the learning process takes place^[10]

2. Instructional media praticity

Practicity of instructional multimedia seen from response of teacher in Questionnaire and student response questionnaire. The results of the practicality of the teacher and student response questionnaire as below.

a. Practicality of teacher response questionnaire

The practicality of interactive instructional multimedia seen from the aspect of ease of use, efficiency learning time and benefits. Based on the results, data processing from questionnaire teacher response, this media has a very high degree of practicality on the aspect of ease of use with the acquisition average moment kappa of 0.83. This is due to instructional media developed displays concepts in chemicals simply and clear, so that the content of the instructional multimedia that have been made easy to understand. The letters was used was clear and easy to read. Instructional multimedia can used anytime, other than that applications are also easy to use on any PC. The practicality of interactive instructional multimedia terms of time efficiency learning obtained high practicality. This value is obtained because this medium can help students learn according to their learning speed each one besides using it media learning time becomes more efficient. This media is able to overcome the limitations of space, time, energy, and sense power^[10].

b. Practicality of Student Response Questionnaire

The practicality of the interactive instructional multimedia of the periodic elemental system is seen from the acquisition of the kappa moment value of each item contained in the sheet students practice. This student's practicality sheet Prepared based on aspects of ease of use, efficiency of learning time and benefits. Based on the results of data processing, interactive instructional multimedias has a high degree of practicality on the aspect of convenience use. This value is obtained because of developing instructional multimedia is

easy to use by students because of the material and its concepts was presented in a simple and clear, so the contents Of instructional multimedia made easy to understand. A good instructional multimedia is a medium has ease of use. Through this medium can also provide learning opportunities to students whenever and anywhere^[12]. Instructional multimedia can be used repeatedly as an exercise for students. The repetition of the exercise will make Information or concepts studied last long In students' memories, so that information or concepts it is not easily forgotten.

Instructional multimedia which developed as well has a high level of practicality on the aspect efficiency of learning time. This value is obtained because this instructional multimedia can help students learn according to their learning speed. . With this media is allowing students self-study according to talent and ability^[10]. developing of interactive instructional multimedia seen from the aspects of benefits have categories almost perfect. This value is obtained because Multimedia which developed can be used by students to learn independently so that students can repeating the lesson anytime and anywhere, assist students in understanding concepts, as well as increased attention and curiosity of students to the media because it is presented with color and attractive design.

This instructional multimedia is also liberating Students to learn according to learning style, speed of learning and free to set goals and the direction of learning. This medium fits the model Independent study because it is considered flexible and not binding^[11]. The value of this high practicality proves that the media which developed has fulfilled the benefits of instructional media among them is the arousal of learning, allowing students self-study according to talent and visual, auditory, and ability kinesthetic^[10].

IV. CONCLUSION AND SUGGESTION

A. Conclusion

Based on the research that has been done, it has been generated interactive instructional multimedia periodic table of chemistry elements for class X SMA. This interactive instructional multimedia has been tested for its validity and Practicability. Based on the results of validity and pratiklity test can be concluded that interactive instructional multimedia on systeperiodic table of chemistry elements has category almost perfect of validity and practicality.

B. Suggestions

Based on the above conclusions regarding the development of interactive learning multimedia subject matter of the periodic system of elements, it is suggested some things as follows.

1. It is advisable to experiment this Multimedia Learning to see if this Multimedia can improve student learning outcomes or not.

2. For Students expected this media can be one of alternative to study material of table periodict of chemistry elements.
3. For other researchers it is expected to develop Multimedia Interactive Learning with other basic material.

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